

REMARKS

This Amendment is responsive to the Office Action dated March 1, 2006. In the amendment, claims 1 and 13 have been amended, and claims 2, 3, 5, 14 and 16 have been canceled without prejudice, such that claims 1, 4, 13, and 15 remain pending in the application. Applicant respectfully requests reconsideration of the pending claims.

These amendments add no new matter. The formation of the 2.5 nm thick Al_2O_3 film for the high-dielectric-constant film is clearly described in Applicant's specification, as is the following formation of the nitride layer having a thickness in the range of 0.2 to 0.3 nm. (See, e.g., U.S. Pub. No. 2004/0164364 at p. 3, ¶¶0048, 0052). The nitriding conditions are also clearly described. (*Id.*, at ¶¶0051-52). Finally, the formation of the boron doped gate electrode, the sidewall spacers and lightly doped drain region are described. (*Id.*, at ¶¶0053-56).

Claims 1-5 and 13-16 have been rejected under 35 U.S.C. § 103(a) as being anticipated by U.S. Pub. No. 2002/0190302 to Bojarczuk ("Bojarczuk"), in view of U.S. Pat. No. 6,563, 182 to Horikawa ("Horikawa") and/or U.S. Pat. No. 6,900,122 to Ahn et al. ("Ahn"). This rejection is traversed.

Independent claim 1 has been amended to recite: [a] *semiconductor device comprising:*

a semiconductor substrate;

a high-dielectric-constant film on the semiconductor substrate, wherein the high-dielectric constant film is composed of Al_2O_3 having a thickness of approximately 2.5 nm; and

a nitride layer on the high-dielectric-constant film, the nitride layer formed by introducing nitrogen into a top surface portion of the high-dielectric-constant film and the nitride layer has a thickness of 0.2 to 0.3 nm, wherein introducing nitrogen into the top surface portion comprises introducing nitrogen gas at 300-400 sccm, for approximately 20-60 seconds, at approximately 10-100 mTorr;

a gate electrode comprising a p-type impurity layer on the nitride layer, wherein the p-type impurity layer is a boron-contained silicon layer; and

a lightly doped drain structure formed by a first introduction of boron to the substrate, a formation of a sidewall spacer adjacent to the gate electrode, and a second introduction of boron to the substrate to form source and drain regions.

These claimed features are neither disclosed nor suggested by Bojarczuk. Bojarczuk discloses a CMOS gate stack having a high dielectric constant gate dielectric and an integrated diffusion barrier. Bojarczuk contains a passing reference to certain materials for a high dielectric constant material, but offers no description whatsoever regarding the details of their implementation. As such, Bojarczuk is devoid of any disclosure or suggestion of various features recited in amended claim 1. In particular, there is absolutely no disclosure in Bojarczuk of having *the high-dielectric constant film ... composed of Al_2O_3 having a thickness of approximately 2.5 nm*, as claimed by Applicant. Furthermore, there is clearly no disclosure or suggestion of the particular nitride layer thickness range, or of the nitriding conditions claimed by Applicant. Thus, Bojarczuk does not disclose or suggest provision of *a nitride layer on the high-dielectric-constant film, the nitride layer formed by introducing nitrogen into a top surface portion of the high-dielectric-constant film and the nitride layer has a thickness of 0.2 to 0.3 nm, wherein introducing nitrogen into the top surface portion comprises introducing nitrogen gas at 300-400 sccm, for approximately 20-60 seconds, at approximately 10-100 mTorr*, as claimed by Applicant. Finally, Bojarczuk does not disclose the particular boron doped gate electrode structure, or the sidewall spacers and lightly doped drain regions that are claimed by Applicant.

Thus, several of the elements recited in Applicant's claim 1 are clearly absent from Bojarczuk. Horikawa and Ahn do not remedy the deficiencies of Bojarczuk. Horikawa discloses a semiconductor device and corresponding process wherein second insulating films of gate insulating films are composed of high-permittivity dielectric film that is doped with an impurity comprising metal ions. Horikawa makes reference to the possibility of composing the dielectric films of PrO_2 . Clearly, the disclosure of this material by Horikawa is clearly in a different context from that claimed by Applicant. Even presuming that it is appropriate to seek combination of Bojarczuk and Horikawa in the fashion proposed by the Examiner, which is not the case, the combination would still fail to produce Applicant's claimed invention, since the particularly claimed composition and thickness of the high-dielectric-constant layer, the particularly claimed thickness range and formation conditions of the nitride layer, and the particularly claimed boron doped gate electrode, sidewall spacers and lightly doped drain

regions by Applicant are all features that are absent from Horikawa. Accordingly, even the combination of Bojarczuk and Horikawa would still fail to produce a *prima facie* case of obviousness.

Ahn is similarly deficient. Ahn discloses implementation of ultra thin praseodymium for a gate dielectric. There is no disclosure nor is there any hint or suggestion in Ahn of Applicant's claimed features as described above. Again, since even the proposed combination would still fail to yield the features of Applicant's claimed invention, it is respectfully submitted that a *prima facie* case of obviousness has not been established.

Independent claim 13 is also neither disclosed nor suggested by Bojarczuk, Horikawa, or Ahn, whether taken alone or in any combination, since that claim also recites the features described in connection with independent claim 1 above. Dependent claims 4 and 15 directly or indirectly incorporate the features in the respective independent claims, as well as their own patentably distinct features, and thus are also neither disclosed nor suggested by the relied upon references.

Accordingly, Applicant respectfully requests reconsideration and withdrawal of the rejection of the claims under 35 U.S.C. § 103(a).

For the foregoing reasons, reconsideration and allowance of the claims which remain in this application are solicited. If any further issues remain, the Examiner is invited to telephone the undersigned to resolve them.

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Respectfully submitted,

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